CLAIMS

1. In a magnetic read head having an air bearing surface (ABS), a magnetic tunnel junction (MTJ) sensor for connection to sense circuitry for detecting changes in electrical resistance within the sensor, the sensor comprising:

a MTJ stack with an active region disposed at the ABS and having two opposite sides each disposed generally orthogonally to the ABS, the MTJ stack comprising:

an antiferromagnetic (AFM) layer spanning the active region,

a pinned layer of ferromagnetic (FM) material in contact with the AFM layer,

a free layer of FM material spanning the active region and extending beyond each of the two opposite sides thereof, and

a tunnel junction layer of electrically nonconductive material disposed between the pinned layer and the free layer in the active region; and

a longitudinal bias layer formed on and in contact with the free layer outside of the active region for biasing the magnetic moment of the free layer in substantially a predetermined direction in the absence of an external magnetic field.

2. The sensor of claim 1 further comprising:

an insulating layer of electrically nonconductive material formed on and in contact with the free layer outside of the active region and in abutting contact with the two opposite sides of the active region.

3. The sensor of claim 2 wherein the longitudinal bias layer is disposed without contacting the active region.

4. The sensor of claim 3 wherein the longitudinal bias layer comprises a hard magnetic (HM) material.

5. The sensor of claim 3 wherein the longitudinal bias layer comprises an AFM material.

6. The sensor of claim 1 wherein the longitudinal bias layer is disposed without contacting the active region.

7. The sensor of claim 6 wherein the longitudinal bias layer comprises a HM material.

8. The sensor of claim 6 wherein the longitudinal bias layer comprises an AFM material.

9. The sensor of claim 1 further comprising:

the longitudinal bias layer comprises an electrically nonconductive AFM material disposed outside of the active region and in abutting contact with the two opposite sides of the active region.

10. The sensor of claim 1 wherein the longitudinal bias layer comprises an electrically nonconductive HM material disposed outside of the active region and in abutting contact with the two opposite sides of the active region.

11. A direct access storage device (DASD) comprising:

a magnetic recording disk having at least one surface for storing magnetically recorded data;

a magnetic read head having an air bearing surface (ABS) disposed for reading the data from the magnetic recording disk surface;

in the magnetic read head, a magnetic tunnel junction (MTJ) sensor comprising:

a MTJ stack with an active region disposed at the ABS and having two opposite sides each disposed generally orthogonally to the ABS, the MTJ stack comprising:

an antiferromagnetic (AFM) layer spanning the active region,

a pinned layer of ferromagnetic (FM) material in contact with the AFM layer,

a free layer of FM material spanning the active region and extending beyond each of the two opposite sides thereof, and

a tunnel junction layer of electrically nonconductive material disposed between the pinned layer and the free layer in the active region; and

a longitudinal bias layer formed on and in contact with the free layer outside of the active region for biasing the magnetic moment of the free layer in substantially a predetermined direction in the absence of an external magnetic field;

an actuator for moving the magnetic read head across the magnetic recording disk surface to access the data stored thereon; and

a data channel having sense circuitry coupled electrically to the MTJ sensor for detecting changes in resistance of the MTJ sensor caused by rotation of the magnetic moment of the free ferromagnetic layer relative to the fixed magnetic moment of the pinned layer responsive to magnetic fields representing the data stored on the magnet recording disk surface.

12. The DASD of claim 11 further comprising:

an insulating layer of electrically nonconductive material formed on and in contact with the free layer outside of the active region and in abutting contact with the two opposite sides of the active region.

13. The DASD of claim 12 wherein the longitudinal bias layer is disposed without contacting the active region.

14. The DASD of claim 13 wherein the longitudinal bias layer comprises a hard magnetic (HM) material.

15. The DASD of claim 13 wherein the longitudinal bias layer comprises an AFM material.

16. The DASD of claim 11 wherein the longitudinal bias layer is disposed without contacting the active region..

17. The DASD of claim 16 wherein the longitudinal bias layer comprises a HM material.

18. The DASD of claim 16 wherein the longitudinal bias layer comprises an AFM material.

19. The DASD of claim 11 further comprising:

the longitudinal bias layer comprises an electrically nonconductive AFM material disposed outside of the active region and in abutting contact with the two opposite sides of the active region.

20. The DASD of claim 11 wherein the longitudinal bias layer comprises an electrically nonconductive AFM material disposed outside of the active region and in abutting contact with the two opposite sides of the active region.

21. In a magnetic read head having an air bearing surface (ABS), a magnetic tunnel junction (MTJ) sensor for connection to sense circuitry for detecting changes in electrical resistance within the sensor, the sensor comprising:

a MTJ stack with an active region disposed at the ABS and having two opposite sides each disposed generally orthogonally to the ABS, the MTJ stack comprising:

an antiferromagnetic (AFM) layer spanning the active region,

a pinned layer of ferromagnetic (FM) material in contact with the AFM layer,

a free layer of FM material spanning the active region, and

a tunnel junction layer of electrically nonconductive material disposed between the pinned layer and the free layer in the active region; and

a nonconductive longitudinal bias layer formed outside of the active region and in abutting contact with the two opposite sides of the active region for biasing the magnetic moment of the free layer in substantially a predetermined direction in the absence of an external magnetic field.

22. The sensor of claim 21 wherein the nonconductive longitudinal bias layer comprises a hard magnetic (HM) material.

23. A direct access storage device (DASD) comprising:

a magnetic recording disk having at least one surface for storing magnetically recorded data;

a magnetic read head having an air bearing surface (ABS) disposed for reading the data from the magnetic recording disk surface;

in the magnetic read head, a magnetic tunnel junction (MTJ) sensor comprising:

a MTJ stack with an active region disposed at the ABS and having two opposite sides each disposed generally orthogonally to the ABS, the MTJ stack comprising:

an antiferromagnetic (AFM) layer spanning the active region,

a pinned layer of ferromagnetic (FM) material in contact with the AFM layer,

a free layer of FM material spanning the active region, and

a tunnel junction layer of electrically nonconductive material disposed between the pinned layer and the free layer in the active region; and

a nonconductive longitudinal bias layer formed outside of the active region and in abutting contact with the two opposite sides of the active region for biasing the magnetic moment of the free layer in substantially a predetermined direction in the absence of an external magnetic field;

an actuator for moving the magnetic read head across the magnetic recording disk surface to access the data stored thereon; and

a data channel having sense circuitry coupled electrically to the MTJ sensor for detecting changes in resistance of the MTJ sensor caused by rotation of the magnetic moment of the free ferromagnetic layer relative to the fixed magnetic moment of the pinned layer responsive to magnetic fields representing the data stored on the magnetic recording disk surface.

24. The sensor of claim 23 wherein the nonconductive longitudinal bias layer comprises a hard magnetic (HM) material.

25. A method for fabricating a magnetic tunnel junction (MTJ) sensor for use in a magnetic read head having an air bearing surface (ABS), the method comprising the unordered steps of:

(a) forming a MTJ stack with an active region disposed at the ABS and having two opposite sides each disposed generally orthogonally to the ABS, including the unordered steps of:

(a.1) forming an antiferromagnetic (AFM) layer,

(a.2) forming a pinned layer of ferromagnetic (FM) material in contact with the AFM layer,

(a.3) forming a free layer of FM material,

(a.4) forming a tunnel junction layer of electrically nonconductive material disposed between the pinned layer and the free layer, and

(a.5) removing all material outside of the active region from the AFM layer, the pinned layer, and the tunnel junction layer to define the two opposite sides of the active region; and

(b) forming a longitudinal bias layer outside of the active region in contact with the free layer for biasing the magnetic moment of the free layer in substantially a predetermined direction in the absence of an external magnetic field.

26. The method of claim 25 further comprising the step of:

(c) forming an insulating layer of electrically nonconductive material on and in contact with the free layer outside of the active region and in abutting contact with the two opposite sides of the active region.

27. The method of claim 26 wherein the longitudinal bias layer is disposed without contacting the active region.

28. The method of claim 27 wherein the longitudinal bias layer comprises a hard magnetic (HM) material.

29. The method of claim 27 wherein the longitudinal bias layer comprises an AFM material.

30. The method of claim 25 wherein the longitudinal bias layer is disposed without contacting the active region.

31. The method of claim 30 wherein the longitudinal bias layer comprises a HM material.

32. The method of claim 30 wherein the longitudinal bias layer comprises an AFM material.

33. The method of claim 25 wherein the forming step (b) further comprises the step of:

(b.1) forming a nonconductive longitudinal bias layer outside of the active region and in abutting contact with the two opposite sides of the active region for biasing the magnetic moment of the free layer in substantially a predetermined direction in the absence of an external magnetic field.

34. The sensor of claim 33 wherein the nonconductive longitudinal bias layer comprises a HM material.

35. The sensor of claim 33 wherein the nonconductive longitudinal bias layer comprises an AFM material.

36. The method of claim 25 wherein the removing step (a.5) further comprises the step of:

(a.5.1) removing all material outside of the active region from the AFM layer, the pinned layer, the tunnel junction layer and the free layer to define the two opposite sides of the active region.

37. The method of claim 36 wherein the forming step (b) further comprises the step of:

(b.1) depositing additional FM material on the free layer in the active region and beyond the two opposite sides of the active region.

38. The method of claim 37 further comprising the step of:

(c) forming an insulating layer of electrically nonconductive material on and in contact with the free layer outside of the active region and in abutting contact with the two opposite sides of the active region.

39. The method of claim 38 wherein the longitudinal bias layer is disposed without contacting the active region.

40. The method of claim 39 wherein the longitudinal bias layer comprises a hard magnetic (HM) material.

41. The method of claim 39 wherein the longitudinal bias layer comprises an AFM material.

42. The method of claim 37 wherein the longitudinal bias layer is disposed without contacting the active region.

43. The method of claim 42 wherein the longitudinal bias layer comprises a HM material.

44. The method of claim 42 wherein the longitudinal bias layer comprises an AFM material.

45. The method of claim 36 wherein the forming step (b) further comprises the step of:

(b.1) forming a nonconductive longitudinal bias layer outside of the active region and in abutting contact with the two opposite sides of the active region for biasing the magnetic moment of the free layer in substantially a predetermined direction in the absence of an external magnetic field.

46. The method of claim 45 wherein the nonconductive longitudinal bias layer comprises a hard magnetic (HM) material.